NASA TECH BRIEF

Lyndon B. Johnson Space Center

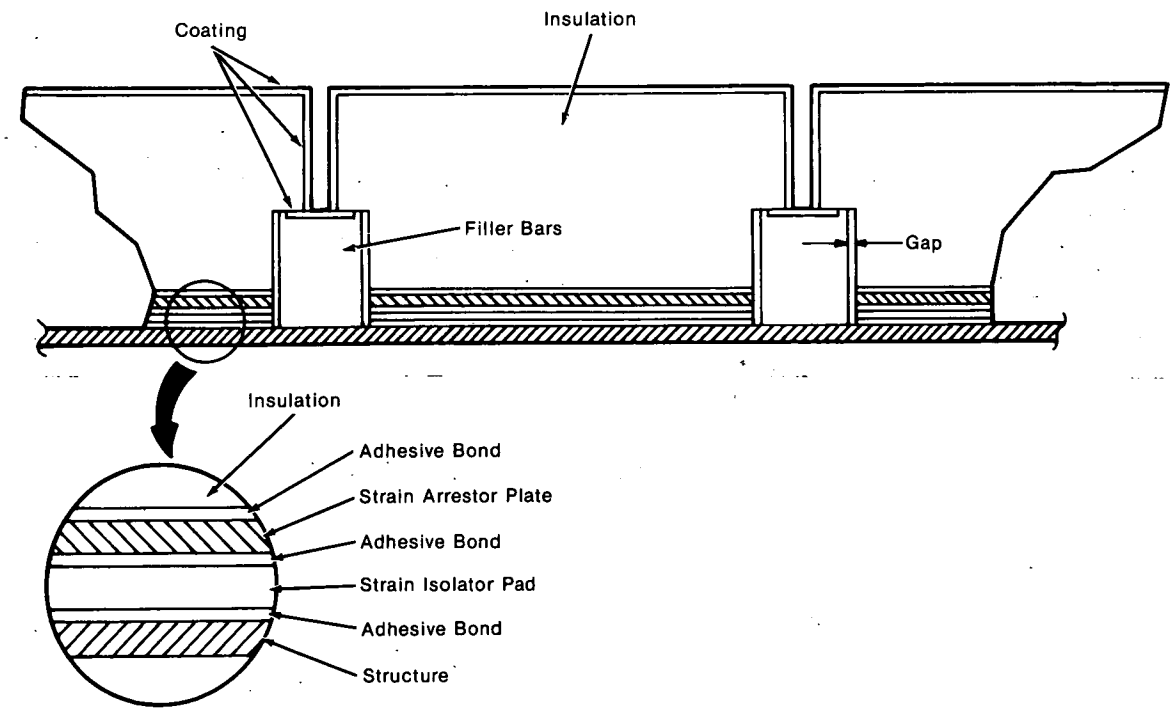
High-Temperature, Reusable Surface Insulation System

A lightweight, high-temperature, reusable surface insulation (HRSI) system has been developed which is capable of withstanding extreme temperature environments ranging from -250° to 2300° F (116 K to 1543 K). The components of this system are shown in the illustration.

The system includes an impervious, high-density, high-thermal-emittance outer coating which has a low coefficient of thermal expansion matching that of the insulation. This coating is applied as a spray and is subsequently bonded to the insulation by firing in a kiln at temperatures above the maximum-use temperature of the coating. (See Note 1.)

The insulation below the coating is a fibrous tile produced from high-purity, amorphous silica fibers having a density of 9 lb/ft^3 (144 kg/m^3). The fibers are processed into castings and have a specific orientation. (See Notes 1b and c.)

The filler bars shown in the illustration provide low-conductivity blockage-to-gap heating for the structural surface between tiles. The bars are also fabricated from the same high-purity fibers as the insulation. However, these fibers are not rigidized and have a lower density of 5 to 6 lb/ft^3 (80 to 96 kg/m^3). Because they are resilient, the bars allow tolerances between the insulation tiles to be less strict and ensure



Insulation System

(continued overleaf)

proper sealing between the tile joints. The upper surface areas of the bars may be coated with the same coating used on the insulation to make them impervious to water and to have a high emittance surface.

The other system components include a waterproofing agent (not shown), a strain arrestor plate, a strain isolator pad, and adhesive bonding agents. The waterproofing agent is applied by immersion of the coated tile in a polydimethylsiloxane fluid diluted with Freon. (See Note 1a.)

The strain arrestor plate acts as a strain barrier between the primary structure and the tile. It has high stiffness and high strength to absorb loads transferred by the bond system from the protected surface, particularly at cryogenic temperatures when the strain isolator pads become stiff. The strain arrestor plate is generally made from graphite-epoxy materials. (See Note 1b.)

The strain isolator pad also decreases the transfer of strain between the primary structure and the tile. It is made from an elastomeric foam with a very low elastic modulus. Pad thicknesses vary with specific applications but are generally in the range of 0.060 to 0.126 in. (1.6 to 3.2 mm).

The adhesive bonds used generally retain strength to a temperature of 350° F (180° C). Flexible elastomeric adhesives are used for bonding the strain isolator pad to the structure and to the strain arrestor plate. On the other hand, epoxy resin adhesives are used to bond the strain arrestor plate to the insulation.

Notes:

1. The reports describing this study are as follows:
   a. Final Report for Improvement of Reusable Surface Insulation Material
      NASA CR-115712 (N72-29588)
   b. Final Report for Development and Design Application of Rigidized Surface Insulation Thermal Protection Systems
      NASA CR-134326 (N74-28339) Vol. I
      NASA CR-134327 (N74-28340) Vol. II
   c. Final Report for Space Shuttle Thermal Protection System Development
      NASA CR-115582 (N75-70146) Vol. I
      NASA CR-115583 (N75-70147) Vol. II

   Copies of these reports may be obtained at cost from:
   Technology Application Center
   University of New Mexico
   Albuquerque, New Mexico 87131
   Telephone: 505-277-3622
   Reference: B75-10042
2. Specific technical questions may be directed to:
   Technology Utilization Officer
   Johnson Space Center
   Code AT3
   Houston, Texas 77058
   Reference: B75-10042

Patent status:

NASA has decided not to apply for a patent.

Source: Lockheed Missiles and Space Co.
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Categories: 04 (Materials)
08 (Fabrication Technology)